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Hay

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(54) **ASEPTIC PRODUCT DISCHARGE VALVE AND METHOD**

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(52) **U.S. Cl.** ..... **137/241**; 134/102.1; 134/166 C; 134/171; 137/15.04

(58) **Field of Search** ..... 134/102.1, 166 C, 134/171; 137/240, 241, 15.06, 15.04, 15.05; 251/63, 63.5, 63.6

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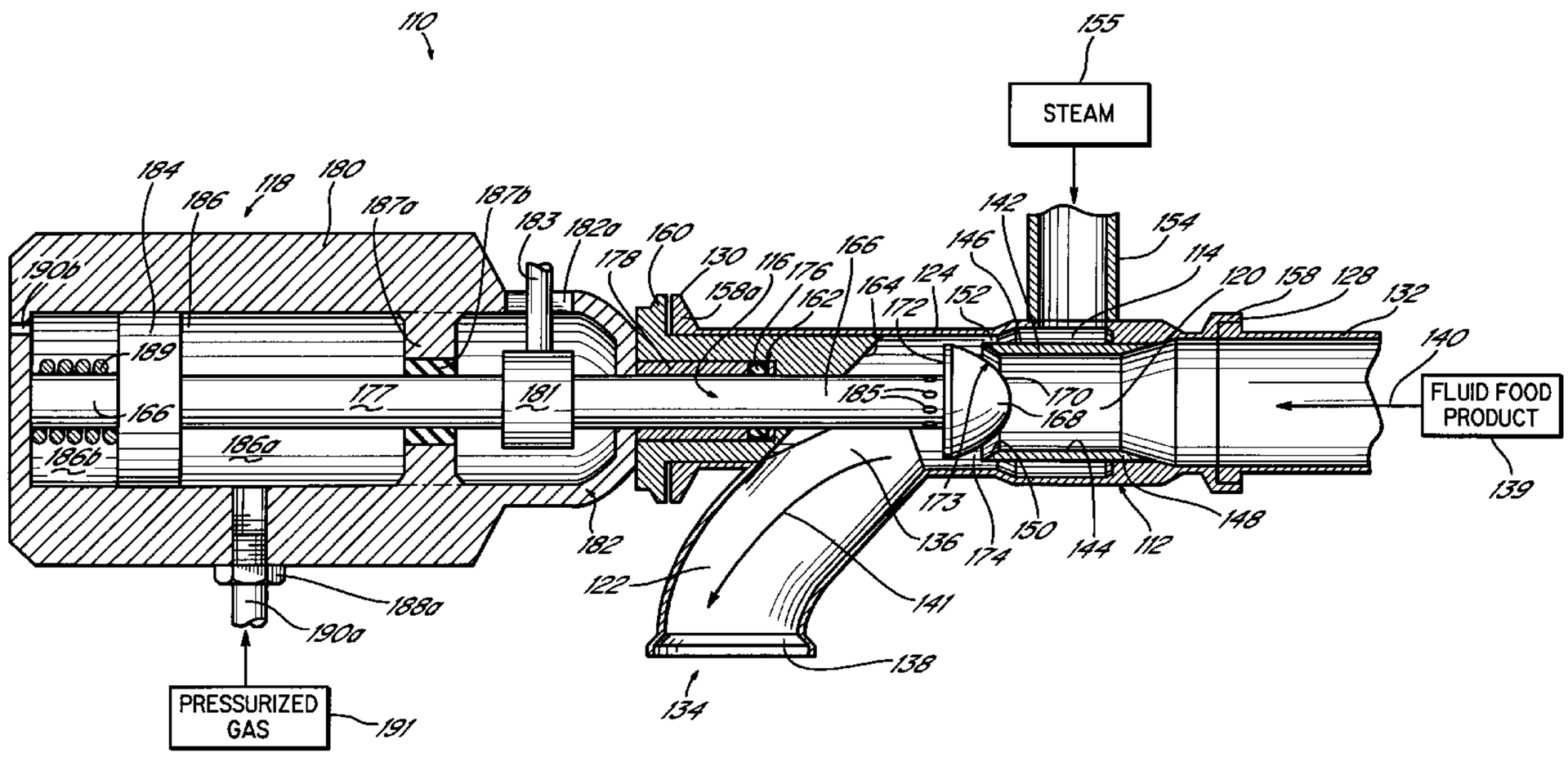
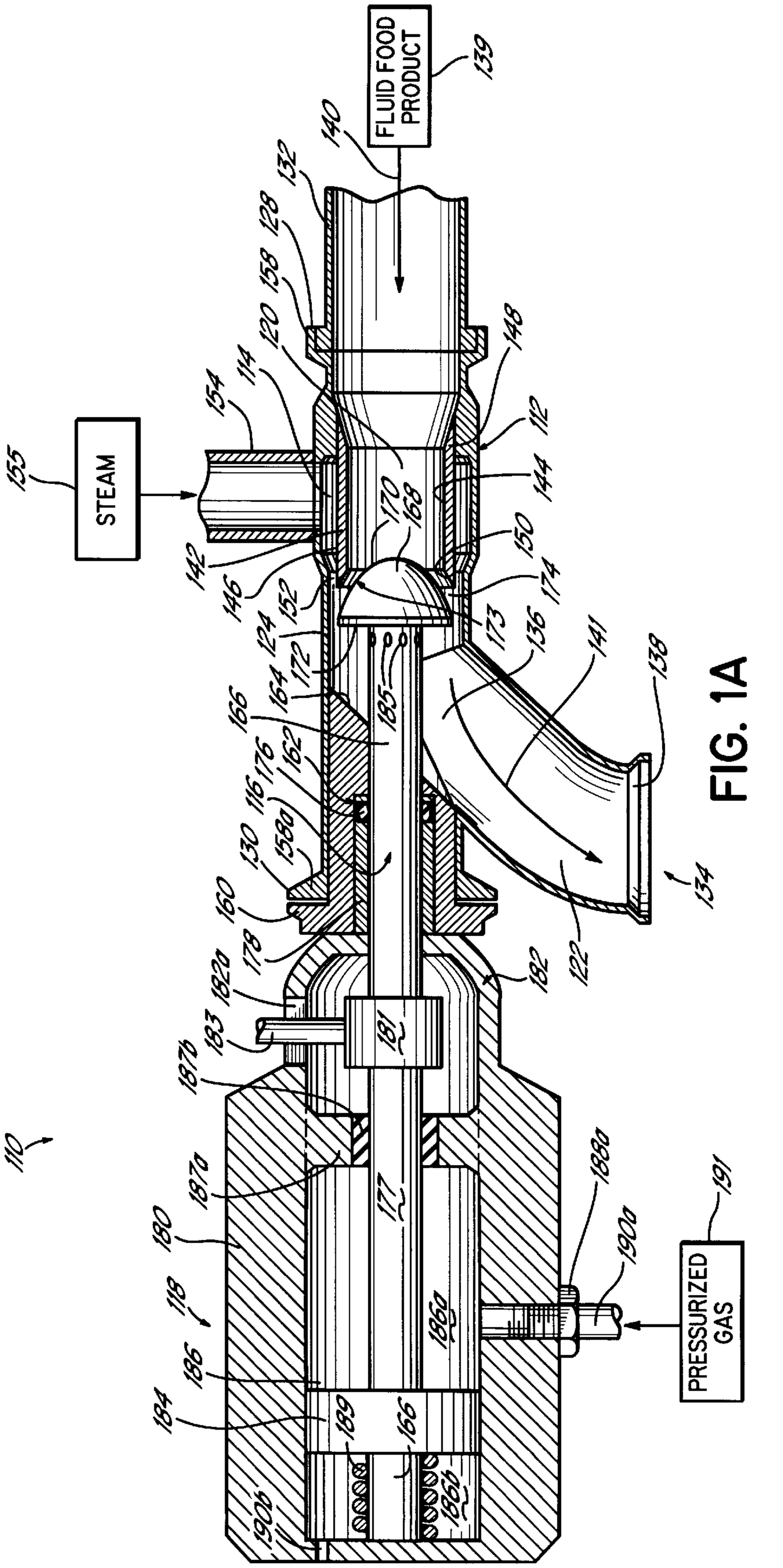
(57) **ABSTRACT**

An aseptic product discharge valve and related methods for injecting steam into a sterile fluid delivery system used to transport a sterile fluid food product. The aseptic product discharge valve includes a tubular member having a longitudinal passageway and an outlet for discharging the flow of food product. The valve also includes a chamber disposed radially outward of the passageway. The chamber receives steam that is exhausted through an opening disposed adjacent to the valve. A valve member is disposed within the longitudinal passageway and fluid food product must flow about the valve member. The diverted flow of fluid food product may be intersected by the flow of injected steam. The tubular body further includes a valve seat which is bathed with the injected steam to promote sterility at the discharge location.

16 Claims, 3 Drawing Sheets




FLUID FOOD PRODUCT
139
140
132
128
158
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114
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STEAM
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170
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146
152
174
124
173
136
141
172
164
166
185
138
162
176
116
130
158a
160
178
134
122
182
1820
183
181
187b
110
187a
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188a
180
190a
118
186
184
189
166
186a
190b
191
PRESSURIZED GAS

FIG. 1A

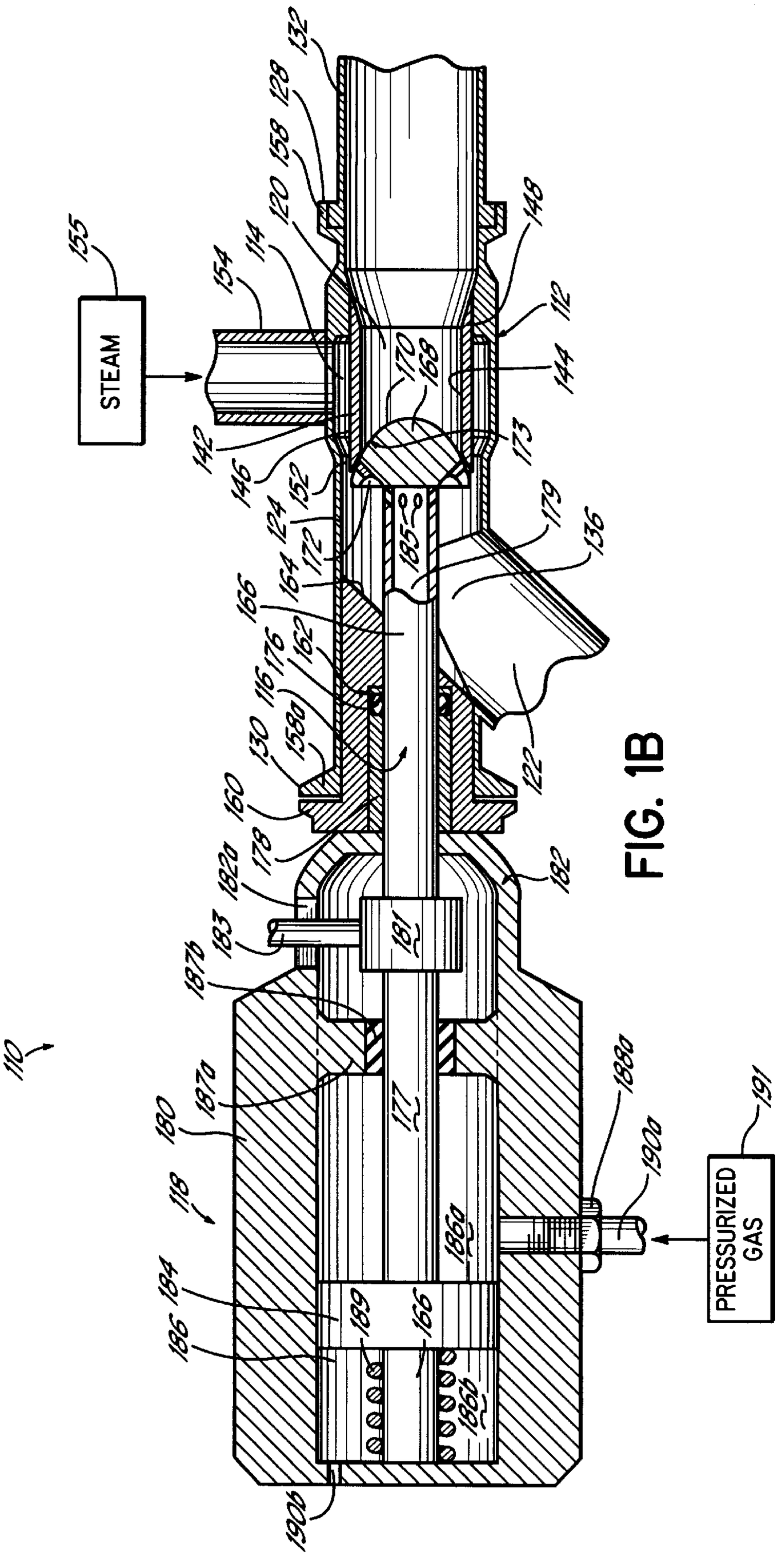
STEAM
PRESSURIZED GAS
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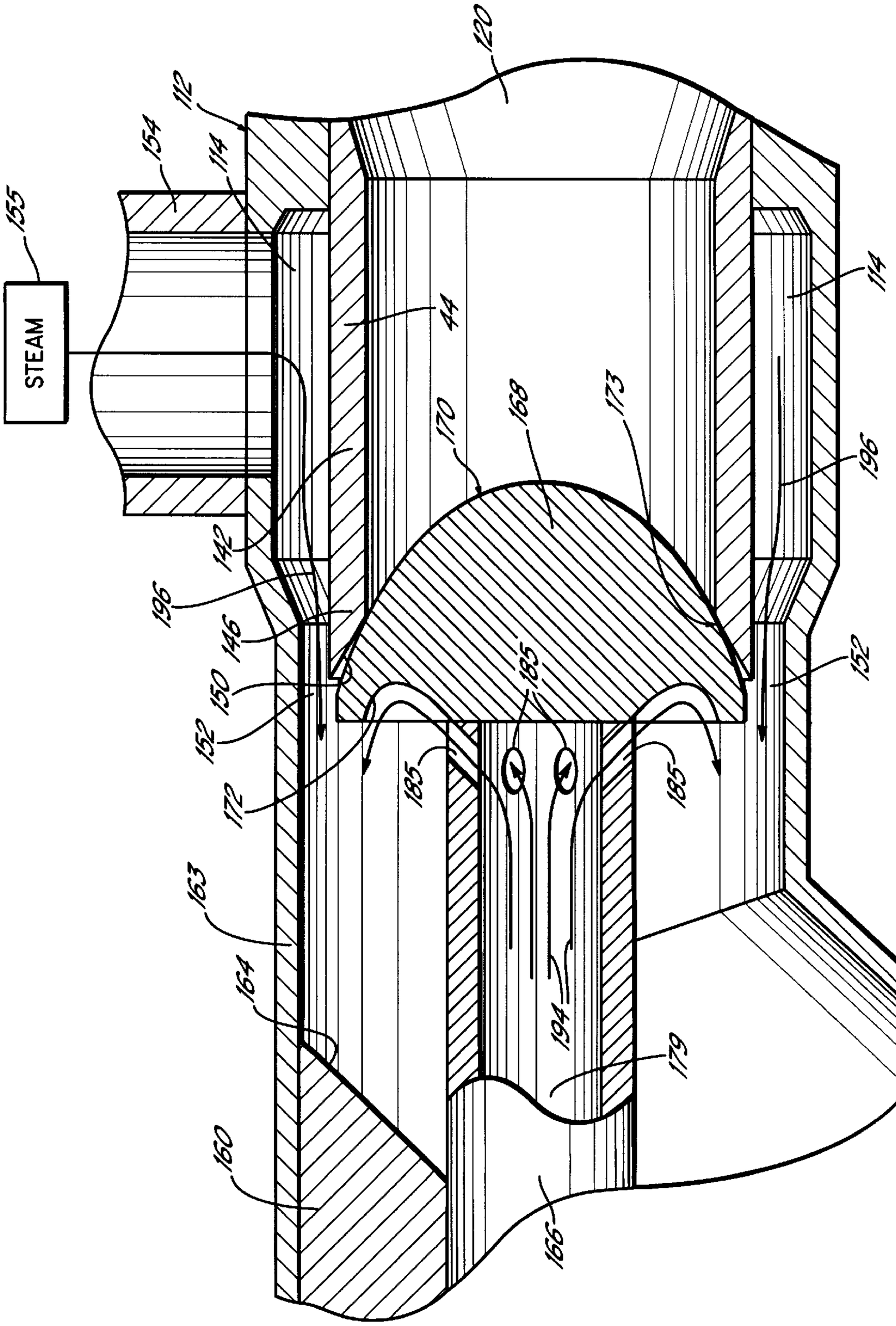
FIG. 1B


120
112
154
114
155
STEAM
44
114
170
168
173
196
142
196
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150
152
185
152
172
185
185
163
164
194
179
160
166

FIG. 2

ASEPTIC PRODUCT DISCHARGE VALVE AND METHOD

FIELD OF THE INVENTION

The present invention relates generally to aseptic valves and, more particularly, to an aseptic product discharge valve and related methods of preventing contamination of a fluid food product processing system by microorganisms.

BACKGROUND OF THE INVENTION

Many fluid food products are aseptically processed to prevent the undesirable effects of microorganism. Aseptic processing can significantly extend the shelf life of most foodstuffs and often involves the continuous sterilization of a fluid food product circulated within a closed process system. In a typical aseptic process, a fluid food product is thermally pasteurized by heating to an elevated temperature for a duration sufficient to reduce the viability of microorganism to acceptable levels. Following pasteurization, the fluid food product is typically transported through a cooling media before packaging into a sterile container. One example of such a system is shown and described in U.S. Pat. No. 5,802,96, which is assigned to the assignee of the present invention. In most processing and packaging operations, the cooling side of the system is much more prone to contamination by microorganism. One potential point of contamination is the occasional requirement to draw off a quantity of sterile product or other media from the sterile atmosphere of an aseptic cooling system to an unsterile atmosphere, such as an open tank or gutter. Over time, microorganisms can migrate up the discharge line and contaminate the system.

Conventional valves produce a fluid tight seal between a movable valve member and a complementary valve seat so as to discontinue or restrict flow. Absent suitable precautions, microorganisms resident in the discharge line downstream of the discharge valve can readily traverse the fluid-tight seal, invade the sterile piping system, and compromise the sterility of the closed process system.

Various manners of dealing with contamination issues in food processing systems have been utilized in the past. One typical system is a double block and bleed valve system which involves using two spaced apart valves in the discharge line with steam injection between the two valves. The valves are sequentially opened and timed with the introduction of stream to maintain sterility at the outlet. Unfortunately, this type of system is rather complicated and still may not maintain optimum sterility at the discharge location.

It would there fore be desirable to provide a product discharge valve, especially useful in the fluid food product industry, which combines simplicity of design with effective sterilization of the discharge location.

SUMMARY OF THE INVENTION

The present invention provides an aseptic product discharge valve that injects steam adjacent the interface between a valve member and an associated valve seat. The aseptic product discharge valve includes a tubular structure having a longitudinal passageway with an outlet for discharging the flow of the fluid food product. The valve further includes a chamber that is positioned radially outward of the longitudinal passageway and a steam conduit for supplying steam to the chamber. In one embodiment, the chamber is an annular chamber having an annular opening into the longitudinal passageway. The valve member may be moved by an actuating assembly configured to move the valve member between a closed position to prevent the flow of fluid food product through the outlet and at least one open position to allow the flow of fluid food product through the outlet. The actuating assembly may be a linear actuator coupled with the valve member by a valve stem.

The aseptic product discharge valve further includes a hollow valve stem having a cavity for receiving steam and a number of radial ports that perforate the hollow member. Steam at super-atmospheric pressure is delivered from a steam conduit attached for fluid communication with the valve stem that supplies steam to fill the cavity. The radial steam ports allow steam to bathe the full circumference of the downstream surface of the valve member. The steam injected from the opening in the annular chamber bathes the valve seat and the upstream surface of the valve member. The multiple steam injection locations form a barrier to the migration of microorganisms either along the inner surface of the discharge conduit or the outer surface of the valve stem, past the interface between the valve member and the valve seat.

Additional features, advantages and objectives of the invention will become more readily apparent to those of ordinary skill in the art upon review of the following detailed description of the preferred embodiments, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1A** is a side view of an aseptic product discharge valve constructed in accordance with a preferred embodiment of the invention;

FIG. **1B** is a side view of the embodiment shown in FIG. **1A**, in which the flow of fluid food product has been blocked; and

FIG. **2** is an enlarged, fragmentary side view of FIG. **1A** showing a section of the aseptic product discharge valve.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. **1A**, **1B** and **2** show side axial cross sections of an aseptic valve, in accordance with the principles of the present invention, wherein the aseptic valve is configured to operate as an aseptic product discharge valve **110**. Referring to FIG. **1A**, aseptic product discharge valve **110** generally includes a tubular body **112** featuring an internal annular chamber **114** that adapted to receive steam for injection, a valve assembly **116** disposed within tubular body **112**, and a valve actuator **118** attached to an opposite end of valve assembly **116**.

Tubular body **112** includes a longitudinal passageway **120** coupled for fluid communication with a passageway **122**. Longitudinal passageway **120** is an open space enclosed, in part, by a cylindrical wall **124** and extends along a longitudinal axis from a first up stream end **128** to a second downstream end **130**. Passageway **122** extends along a curvilinear axis toward an outlet **1 24** to an opening **130** in cylindrical wall **124**. First upstream end **128** of longitudinal passageway **120** is attached to a delivery conduit **132** for receiving a flow of a sterile fluid food product from a supply **139**, as shown by arrow **140**. Passageway **122** accepts fluid food product discharged from longitudinal passageway **120**, redirects the flow by approximately 90°, and exhausts the redirected flow through outlet **134** as shown by arrow **141**. Outlet **134** is circumscribed by an integral flange **138**

adapted to attach in a fluid-tight manner to a complementary flanged end carried by a discharge conduit (not shown).

An inner tubular member **142** is disposed within longitudinal passageway **120**. In the embodiment shown in FIG. **1**A, inner tubular member **142** is substantially coaxial and substantially concentric with longitudinal passageway **120**. Inner tubular member **142** includes a generally cylindrical wall **144** disposed radially inward from cylindrical wall **124** and has a first end **146** spaced apart from a second end **148**. A frustoconical rim or end **150** encircles the inner circumference of inner tubular member **142** near first end **146**. Rim **150** provides an annular beveled edge that functions as a valve seat, as will be dicussed below.

Annular chamber **114** comprises an open steam-receiving volume surrounding inner tubular member **142**. Second end **148** of inner tubular member **142** is circumferentially sealed in a fluid-tight fashion with the interior of cylindrical wall **124**. Annular chamber **114** includes an annular opening **152** disposed radially outward of frustoconical rim **150**. A steam conduit **154** penetrates cylindrical wall **124** to supply annular chamber **114** with steam at a super-atmospheric pressure generated by a remote steam source **155**.

Cylindrical wall **124** further includes integral flanges **158**, **158***a* at respective first and second opposite ends **128**, **130** that make a fluidtight seal with a Complementary flange. End **130** receives a flanged insert **160** having a central stepped bore **162** and a curvilinear interior face **164**. Angled face **164** sustains the streamline flow of fluid food product into passageway **122**. Fluid food product **139** that has been pasteurized upstream from valve assembly **116** to eliminate or substantially reduce entrained microorganisms is discharged from outlet **134**.

Valve assembly **116** is disposed within longitudinal passageway **120** and includes a valve stem **166** attached to the base of a valve member **168**. Valve member **168** includes a bulbous rounded surface **170** on the upstream side and an annular cusped surface **172** on the downstream side. Of course, the shapes and contours of surface **170** and surface **172** are not intended to be limiting in any way and may be varied without departing from the scope and spirit of the present invention. Valve member **168** is preferably composed of a stainless steel that can tolerate both the wear associated with the streaming food product and injected steam and the direct heat of the injected steam.

A portion of bulbous rounded surface **170** presents a sealing surface **173** that sealingly engages frustoconical rim **150** (FIG. **2**) or, when separated from rim **150**, forms pathway **174**. Fluid food product emerges from annular pathway **174** as a thin diverging annular flow of fluid food product. The width of pathway **174** will contribute to establishing the flow rate of fluid food product through aseptic product discharge valve **110** and the radial thickness of the diverging annular flow. It may be appreciated by one of ordinary skill in the art that other geometrical configurations and shapes of sealing surface **173** and rim **150** are possible for varying the configuration of pathway **174**, the relative positioning of opening **152**, and the relative direction of the flow path of fluid food product without departing from the spirit and scope of the present invention.

Valve stem **166** extends axially away from an attachment point near the center of valve member **168** and through stepped bore **162**. A hollow bushing **178** is coaxially received within the larger diameter portion of stepped bore **162**. An O-ring **176** is carried by a circumferential groove formed in the inner surface of bushing **178**. O-ring **176** compressively engages a length of the outer surface of valve stem **166** to form a substantially fluid-tight dynamic seal. An opposite end of valve stem **166** is connected to an actuator finger **177** of valve actuator **118**.

As shown in FIG. **1**B, valve stem **166** may further include a longitudinal cavity **179**. Steam is delivered at a super-atmospheric pressure to cavity **179** via a steam conduit **183** through a fitting **183**. A slot **182***a* allows back and forth movement of conduit **183**. Valve stem **166** further includes a plurality of radial steam ports **185** that vent s team outwardly from internal cavity **179** so that cusped surface **172** is bathed by steam.

Valve actuator **118** includes an outer housing **180** that attaches to flanged insert **160**. An opposite end of actuator finger **177** connects to a piston **184** that bisects a chamber **186** enclosed within outer housing **180** into two portions **186***a*, **186***b*. Portion **186***a* includes a fitting **188***a* that extends through outer housing **180**. Fitting **188***a* is adapted to supply or exhaust pressurized gas through a conduit **190***a* coupled to a source **191** of the pressurized gas. A vent **190***b* is provided to vent air from chamber portion **186***b*.

If pressurized gas fills chamber portion **186***a* as depicted in FIG. **1**A, piston **184** will urge valve assembly **116** and separate valve member **168** from frustoconical rim **150** against the bias of a spring **189** in chamber portion **186***b*. A ring **187***a* may be welded within housing **180** to carry a seal **187***b* engaged with finger or rod **177** to allow air pressure to build in chamber portion **186***a*. When the pressurized gas is exhausted as depicted in FIG. **1**B, valve assembly **116** will be forced by spring **189** in an opposite direction so that valve member **168** contacts rim **150** and the flow of fluid food product is at least substantially blocked. In such a contacting state, sufficient force must be applied to piston **184** so as to resist the countervailing force applied by the static pressure of food product located upstream of valve member **168**.

FIG. **2** schematically illustrates the flows of fluid food product and steam through a segment of longitudinal passageway **120** proximate to valve member **168**. In operation, fluid food product that has been sterilized is received by conduit **132**. When valve assembly **116** is actuated to a closed position, a steam is admitted into internal cavity **179** and into annular chamber **114**. Alternatively, steam may be continuously admitted into internal cavity **179** regardless of whether valve assembly **116** is actuated to a closed position or an open position. If the steam is draining under gravity to a waste receptacle, steam must be provided to annular chamber **114** at a pressure of greater than about 5 psi to establish a positive flow of steam. However, a greater pressure of steam may be required if the flow must overcome a hydrostatic barrier.

Steam exits annular opening **152** as a thin annular flow that bathes the backside of frustoconical rim **150** and a peripheral annulus of bulbous rounded surface **170**. The flow of steam is indicated by arrows **196**. Steam is simultaneously emitted as indicated by arrows **194**, from each radial steam port **185** to bathe annular cusped surface **172**. The two converging baths of steam form an effective thermal barrier. The steam also eliminates or aseptically reduces microorganisms migrating from the discharge line into passageway **122**. The pressure and temperature of steam in steam conduits **154**, **183** (FIG. **1**B) may be regulated by valves interfaced with control circuitry (not shown). While not shown, it will be appreciated that the control circuitry is well known to one of ordinary skill in the art and includes appropriate components for operating aseptic product discharge valve **110**.

While the present invention has been illustrated by a description of various embodiments and while these

embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

The scope of the invention itself should only be defined by the appended claims, wherein I claim:

1. An aseptic product discharge valve for use in a fluid delivery system for a fluid food product, the aseptic product discharge valve comprising:

a tubular structure including a longitudinal passageway having respective upstream and downstream ends, the upstream end comprising an inlet for receiving a flow of the fluid food product and the downstream end comprising an outlet for discharging said fluid food product;

a valve seat disposed in said longitudinal passageway downstream of said outlet, said valve seat facing the downstream end;

a movable valve member mounted within said longitudinal passageway downstream of said valve seat, said valve member positioned for selective sealing engagement with said valve seat;

a walled chamber disposed radially between said tubular structure and said longitudinal passageway, the chamber having an opening disposed at a radially outward, adjacent location relative to said valve seat; and

a steam conduit attached for fluid communication with said chamber for supplying steam to said chamber such that the steam exits at the opening of said chamber and contacts at least one of the valve seat and the upstream portion of said valve member.

2. The aseptic product discharge valve of claim **1**, wherein said movable valve member includes a valve stem and wherein said chamber is an annular chamber disposed about the longitudinal passageway and said opening is an annular opening generally circumscribing said valve seat.

3. The aseptic product discharge valve of claim **2**, further comprising an actuating assembly coupled with said valve member, said actuating assembly configured to move the valve member between a closed position to prevent the flow of said fluid food product through the outlet and at least one open position to permit the flow of said fluid food product through the outlet.

4. The aseptic product discharge valve of claim **2**, further comprising a plurality of steam ports in said valve member, each steam port configured to receive and direct steam at the upstream portion of said valve member.

5. The aseptic product discharge valve of claim **1**, wherein said valve member further includes steam ports configured to receive and direct steam at said valve seat when said valve member is in sealing engagement with said valve seat.

6. The aseptic product discharge valve of claim **1**, wherein the downstream end of the longitudinal passageway has a linear portion and a curvilinear portion intersecting with the linear portion and extending outwardly therefrom, the linear portion receiving said movable valve member therein and the outlet of the longitudinal passageway being within the curvilinear portion.

7. An aseptic product discharge valve for maintaining the sterility of an aseptic process for a fluid food product, the discharge valve comprising:

a tubular structure including a longitudinal passageway having respective upstream and downstream ends, the upstream end comprising an inlet for receiving a flow of the fluid food product and the downstream end comprising an outlet for discharging said fluid food product;

a valve seat disposed in said longitudinal passageway upstream of said outlet, said valve seat facing the downstream end;

a movable valve member mounted within said longitudinal passageway downstream of said valve seat, said valve member facing said valve seat for selective sealing engagement with said valve seat;

a walled chamber disposed radially between said tubular structure and said longitudinal passageway, said chamber having an opening disposed radially outward of said valve seat;

a steam conduit attached for fluid communication with said chamber for supplying steam to said chamber such that the steam exits at the opening of said chamber downstream of the valve seat; and

a valve stem attached to said valve member, said valve stem having a cavity therein for receiving steam and at least one steam port communicating with said cavity and configured to direct steam from said cavity generally toward said valve member.

8. The aseptic product discharge valve of claim **7**, wherein said chamber is an annular chamber disposed about the longitudinal passageway and said opening is an annular opening generally circumscribing said valve seat.

9. The aseptic product discharge valve of claim **8**, further comprising an actuating assembly coupled with said valve stem, said actuating assembly configured to move the valve member between a closed position to prevent the flow of said fluid food product through the outlet and at least one open position to permit the flow of said fluid food product through the outlet.

10. The aseptic product discharge valve of claim **8**, further comprising a plurality of steam ports in said valve stem, each steam port communicating with said cavity and configured to direct steam at a different portion of said valve member.

11. The aseptic product discharge valve of claim **7**, wherein said valve member further includes steam ports configured to receive and direct steam at said valve seat when said valve member is in sealing engagement with said valve seat.

12. The aseptic product discharge valve of claim **7**, wherein the downstream end of the longitudinal passageway has a linear portion and a curvilinear portion intersecting with the linear portion and extending outwardly therefrom, the linear portion receiving said movable valve member therein and the outlet of the longitudinal passageway being within the curvilinear portion.

13. A method for maintaining sterile conditions at a valve configured to discharge a fluid food product from a food processing system, the valve comprising a movable valve member and a valve seat disposed in a discharge passageway having respective upstream and downstream ends, the valve member coupled to a stem having an interior cavity for receiving steam and at least one port communicating with the interior cavity, and a chamber disposed radially between the discharge passageway and an outer tubular structure, the chamber including an opening which is positioned generally adjacent the valve seat, the method comprising:

supplying a flow of the fluid food product into the upstream end of the discharge passageway;

directing the flow of the fluid food product around the valve member toward the downstream end of the discharge passageway;

injecting steam through the opening and adjacent the valve seat into contact with the valve seat and an upstream portion of the valve member; and

injecting steam through the at least one port of the valve stem and into contact with a downstream portion of the valve member.

14. The method of claim **13**, wherein the injecting step further comprises:

injecting the steam in an annular path around and adjacent the valve seat.

15. The aseptic product discharge valve of claim **10**, wherein said valve member has an upstream valve seat engageable surface for selective sealing engagement with said valve seat, said valve member having a downstream concave surface with a periphery adjacent the valve seat engageable surface, and wherein said steam ports direct steam onto said concave surface whereupon steam merges with steam emerging from the opening of said chamber to establish therewith an effective thermal barrier.

16. The method of claim **13**, further comprising, before the steps of injecting steam, engaging the valve member with the valve seat to stop the flow of the fluid food product through the discharge passageway.

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